ECOSYSTEM STATUS INDICATORS

Ecosystem or Community Indicators

Average local species richness and diversity of the groundfish community

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Last updated: September 2005

Description of indices: This section provides indices of local species richness and diversity based on standard bottom trawl surveys in the western (west of 147°N) Gulf of Alaska (GoA) and Eastern Bering Sea (EBS). The average number of fish taxa per haul and the average Shannon-Wiener index of diversity (Magurran 1988) by haul were computed based on CPUE (by weight) of each fish species (or taxon). Indices were based on a total of 55 fish taxa in the GoA and 47 fish taxa in the EBS. Taxa were included at the lowest possible taxonomic level, i.e. at a level that was consistently identified throughout all surveys. Indices were computed following Mueter & Norcross (2002). Briefly, annual average indices of local richness and diversity were estimated by first computing each index on a per-haul basis, then estimating annual averages by modeling haul-specific indices as a function of geographic location, depth, date of sampling, area swept, and year.

Status and trends: Average species richness and diversity of the groundfish community in the Gulf of Alaska increased from 1990 to 1999 with both indices peaking in 1999 and sharply decreasing thereafter (Figure 107). Species richness and diversity on the Eastern Bering Sea shelf have undergone significant variations from 1982 to 2004 (Figure 108). Species diversity increased from 1983 through the early 1990s, was relatively high and variable throughout the 1990s, decreased significantly after 2001, and increased again to its long-term average in 2004.

F**actors causing observed trends**: The average number of species per haul depends on the spatial distribution of individual species (taxa). If species are, on average, more widely distributed in the sampling area the number of species per haul increases. Spatial shifts in distribution from year to year lead to high variability in local species richness in certain areas, for example along the 100m contour in the Eastern Bering Sea. These shifts appear to be the primary drivers of changes in species richness.

Local species diversity is a function of the number of species and their relative abundance in each haul. In the GoA average species diversity followed changes in local richness. In contrast, trends in species diversity in the EBS differed from those in richness. For example, low species diversity in the EBS in 2003 occurred in spite of high average richness, primarily because of the high dominance of walleye pollock, which increased from an average of 18% of the catch per haul in 1995-98 to 30% in 2003, but decreased again to an average of 21% in 2004. The effect of fishing on species richness and diversity are poorly understood at present. Because fishing primarily reduces the relative abundance of some of the dominant species in the system, species diversity is expected to increase relative to the unfished state. However, changes in local species richness and diversity are strongly confounded with natural variability in spatial distribution and relative abundance.

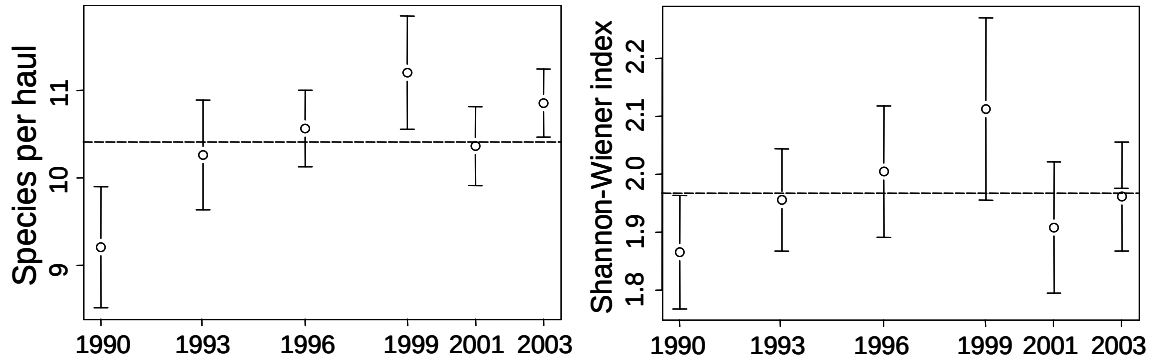

Figure 107. Model-based annual averages of species richness (average number of species per haul), and species diversity (Shannon-Wiener index) in the western Gulf of Alaska, 1990-2003, based on 55 fish taxa collected by standard bottom trawl surveys with 95% confidence intervals. Model means were adjusted for differences in area swept, depth, date and time of sampling, and geographic location among years.

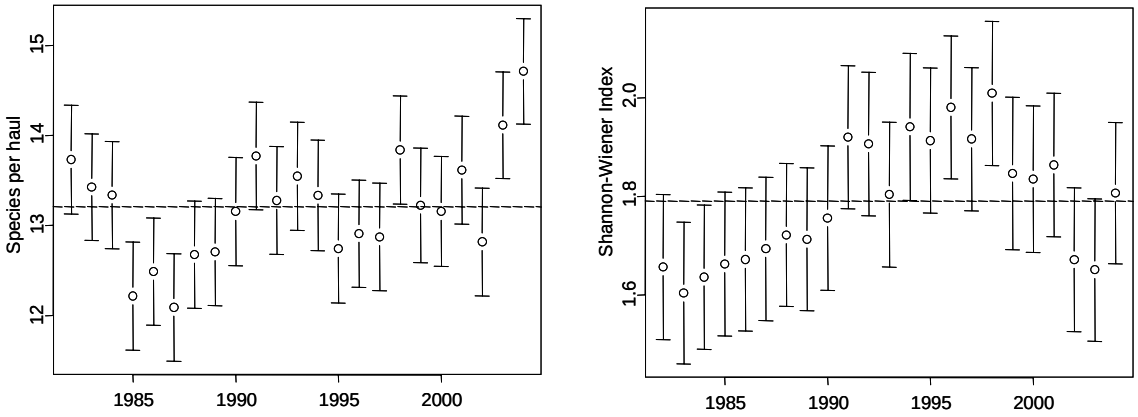

Figure 108. Model-based annual averages of species richness (average number of species per haul), and species diversity (Shannon-Wiener index) in the Eastern Bering Sea, 1982-2004, based on 47 fish taxa collected by standard bottom trawl surveys with 95% confidence intervals. Model means were adjusted for differences in area swept, depth, date of sampling, bottom temperature, and geographic location among years.